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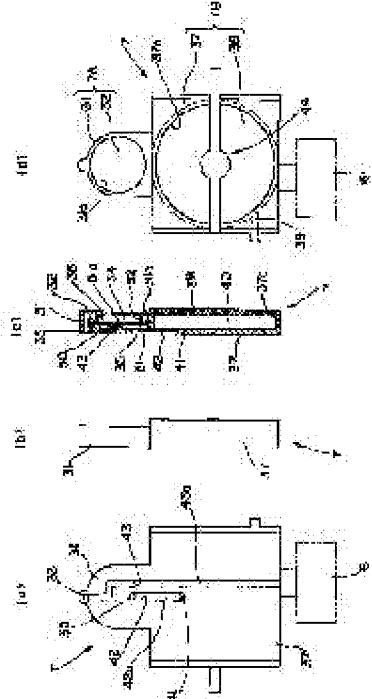
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**(54) INK-JET RECORDER AND METHOD FOR SUPPLYING INK THERETO**



(57)Abstract:

**PROBLEM TO BE SOLVED:** To provide an ink-jet recorder and a method for supplying ink thereto whereby good printing is realized and the whole of a sub tank can be made compact.

**SOLUTION:** There are provided a recording head 6 for discharging ink drops correspondingly to printing data, a main tank for supplying ink to the recording head 6, and the sub tank 7 having upper and lower two tanks 7A and 7B connected to the main tank and the recording head 6 and communicating with each other. The upper tank 7A of the sub tank 7 is formed by an ink tank having an ink outlet 33 for leading out the ink to the recording head 6, and the lower tank 7B is formed by an ink tank which has an ink inlet 39 for leading in the ink from the main tank 9 by a pump pressure and which elastically deforms in accordance with a change of an internal pressure.

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**CLAIMS**

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[Claim(s)]

[Claim 1] The carriage to which it can go and come back, and the recording head with which this carriage is equipped and which carries out the regurgitation of the ink droplet corresponding to print data, It connects with the Maine tank, this Maine tank, and said recording head for supplying ink to this recording head. And said carriage is equipped and it has the subtank which has the tank of two upper and lower sides which each opens for free passage mutually. It forms by the ink tank which has ink derivation opening which derives ink for the upper part tank of this subtank to said recording head. The ink jet type recording device characterized by forming by the ink tank which has the ink inlet which introduces the ink from said Maine tank for a lower part tank by pumping pressure, and carries out elastic deformation according to change of internal pressure.

[Claim 2] The ink jet type recording device indicated by claim 1 characterized by some tank walls in said lower part tank consisting of elastic membrane.

[Claim 3] The ink jet type recording device indicated by claim 2 characterized by forming said elastic membrane with the ingredient which has flexibility, ink-proof nature, and moisture and gas impermeability.

[Claim 4] The ink jet type recording device indicated by either claim 1 characterized by arranging the check valve opened by generating negative pressure in said upper part tank at said recording head side thru/or claim 3.

[Claim 5] The ink jet type recording device indicated by either claim 1 characterized by having an amount detection means of ink by which the elastic deformation detects the amount of ink in said subtank thru/or claim 4.

[Claim 6] The carriage to which it can go and come back, and the recording head with which this carriage is equipped and which carries out the regurgitation of the ink droplet corresponding to print data, It connects with the Maine tank, this Maine tank, and said recording head for supplying ink to this recording head. And said carriage is equipped and it has the subtank which has the tank of two upper and lower sides which each opens for free passage mutually. It is the approach of supplying ink to said recording head from said Maine tank through this subtank. The ink supply approach of the ink jet type recording device which is characterized by carrying out elastic deformation of said lower part tank according to change of internal pressure in supplying ink to said recording head from said Maine tank.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Field of the Invention] This invention relates to the ink jet type recording device which equipped the recording head with the two main-sub ink tank (the Maine tank and subtank) for supplying ink, and its ink supply approach.

#### [0002]

[Description of the Prior Art] The ink jet type recording apparatus is equipped with the recording head which is generally carried on carriage and moves crosswise [ of a record form ], and a paper feed means to move a record form in the migration direction of this recording head, and the direction which intersects perpendicularly relatively. In such an ink jet type recording apparatus, printing to a record form is performed by making an ink droplet breathe out from a recording head based on print data. And black, yellow, cyanogen, and the recording head in which the regurgitation [ each ink of a Magenta ] is possible are carried on carriage, and full color printing is enabled by changing the regurgitation rate of not only the text print in black ink but each ink.

[0003] For this reason, the ink cartridge which supplies each ink to a recording head is arranged in the body of equipment. If it is in the usual ink jet type recording apparatus, each ink cartridge in which the ink of said black, yellow, cyanogen, and a Magenta was stored is laid on carriage, and moves with carriage. On the other hand, in order to make it correspond to comparatively a lot of printing in this kind with which for example, for office or business use is provided of recording device, the mass ink cartridge in which each above mentioned ink was stored is not arranged on carriage, but is arranged at the body side of equipment.

[0004] Moreover, while arranging the Maine tank as an ink cartridge to the body side of equipment (cartridge holder), the recording device of the format which arranges a subtank on the carriage with which the recording head was carried is also offered. And ink is supplied from each Maine tank through an ink supply tube to each subtank, respectively, and it is constituted so that ink may be further supplied from each subtank to a recording head, respectively.

[0005] In such a recording device, performing printing, in order to raise a throughput, ink is serially supplied from each Maine tank to each subtank, and a function which is stabilized and supplies ink from each subtank to a recording head, respectively is called for.

[0006] By pressurizing the ink pack in the Maine tank with air as a means for making such a function satisfy, for example, an ink style is generated from the Maine tank to a subtank, and the configuration which enables supply of ink to a subtank is adopted suitably. In addition, in each subtank carried on carriage, it becomes possible to always store the ink of about 1 quantum in each subtank by adopting the configuration which can adjust the amount of acceptance of the ink from the Maine tank according to consumption of the ink in a recording head.

[0007] By the way, in the latest recording apparatus, carriage is increasingly moved from the purpose which aims at improvement in a recording rate at high speed. In such a recording apparatus, by elongation and crookedness of the ink supply tube accompanying

the acceleration and deceleration of carriage, pressure fluctuation arises in the internal ink, and the regurgitation of the ink droplet from a recording head is made unstable. For this reason, a subtank is made to open wide in atmospheric air, the fluctuating pressure described above from this clear aperture is missed, and the ink supply system of the open sand mold which supplies the ink stored in the subtank to a recording head according to that water head difference is adopted.

[0008]

[Problem(s) to be Solved by the Invention] However, that an ink supply system is an open sand mold has the problem as shown below. That is, in order that a subtank may open in atmospheric air, it is the problem that air bubbles will be able to be contained in ink within a subtank at the time of ink supply, whenever [ degassing / of the ink supplied to a recording head ] cannot be guaranteed, and good printing cannot be realized.

Moreover, since supply of the ink from a subtank to a recording head is performed by the water head difference of the ink in a subtank, it will be necessary to fully secure the height dimension of a subtank, and there is also a problem that the whole subtank is enlarged.

[0009] It aims at offering the ink jet type recording device which can attain the miniaturization of the whole subtank, and its ink supply approach while this invention is made in order to solve such a technical technical problem, and it can realize good printing.

[0010]

[Means for Solving the Problem] The ink jet type recording device concerning this invention made in order to attain the above mentioned purpose The carriage to which it can go and come back, and the recording head with which this carriage is equipped and which carries out the regurgitation of the ink droplet corresponding to print data, It has the subtank which has the tank of two upper and lower sides which connect with the Maine tank, this Maine tank, and said recording head for supplying ink to this recording head, and said carriage is equipped, and each opens for free passage mutually. It is formed by the ink tank which has ink derivation opening with which the upper part tank of this subtank derives ink to said recording head. It is characterized by being formed by the ink tank which a lower part tank has the ink inlet which introduces ink from said Maine tank, and carries out elastic deformation according to change of internal pressure.

[0011] Thus, since it is constituted, after the ink in the Maine tank flowing in the lower part tank of a subtank by pumping pressure at the time of ink supply and flowing on an upper part tank from this lower part tank further, a recording head is supplied from this upper part tank. Under the present circumstances, if pressure fluctuation arises in a lower part tank (ink in the ink supply tube which connects the Maine tank and a subtank), according to change of internal pressure (volume), a lower part tank will carry out elastic deformation, and this pressure (volume) change will be absorbed.

[0012] Therefore, since the ink from the Maine tank can be supplied to a recording head with the ink supply system of closed mold, air bubbles cannot be contained in ink within a subtank like before at the time of ink supply, but whenever [ degassing / of ink ] can be guaranteed, and good printing can be realized. Moreover, since supply of the ink from a subtank to a recording head can carry out with the negative pressure generated in a recording head side, the height dimension of a subtank can be shortened and the miniaturization of the whole subtank can also be attained.

[0013] In this case, it is desirable for some tank walls in said lower part tank to consist of elastic membrane. Thus, since it is constituted, if pressure fluctuation arises in a lower part tank, some tank walls will carry out elastic deformation according to the pressure variation in a lower part tank.

[0014] And said elastic membrane is considered as the configuration currently formed with the ingredient which has flexibility, ink-proof nature, and moisture and gas impermeability. Thus, since it is constituted, a subtank with the elastic membrane which moisture and gas did not penetrate and was excellent in flexibility and ink-proof nature can be obtained.

[0015] Moreover, it is desirable to arrange the check valve opened by generating negative pressure in said upper part tank at said recording head side. Thus, since it is constituted, negative pressure is generated, a check valve is made into a valve-opening condition, and supply of the ink to a recording head becomes possible from the Maine tank through a subtank at a recording head side.

[0016] And it is desirable to have an amount detection means of ink by which the elastic deformation detects the amount of ink in said subtank. Thus, since it is constituted, by the amount detection means of ink, the elastic deformation of a subtank is detected and the amount of ink in a subtank is managed.

[0017] On the other hand, the ink supply approach of the ink jet type recording device concerning this invention The carriage to which it can go and come back, and the recording head with which this carriage is equipped and which carries out the regurgitation of the ink droplet corresponding to print data, The Maine tank for supplying ink to this recording head by pumping pressure, It has the subtank which has the tank of two upper and lower sides which connect with this Maine tank and said recording head, and said carriage is equipped, and each opens for free passage mutually. It is the approach of supplying ink to said recording head from said Maine tank through this subtank, and in supplying ink to said recording head from said Maine tank, it is characterized by carrying out elastic deformation of said lower part tank according to change of internal pressure.

[0018] Since it is such an approach and the ink from the Maine tank can be supplied to a recording head with the ink supply system of closed mold, air bubbles are not contained in ink within a subtank like before at the time of ink supply, but the ink jet type recording device which guarantees whenever [ degassing / of ink ] and realizes good printing can be obtained. Moreover, since supply of the ink from a subtank to a recording head can carry out with the negative pressure by the side of a recording head to generate, the height dimension of a subtank can be shortened and the ink jet type recording device which can attain the miniaturization of the whole subtank can also be obtained.

[0019] [Embodiment of the Invention] Hereafter, based on the gestalt of operation shown in drawing, it explains about the ink jet type recording device with which this invention was applied, and its ink supply approach. First, it explains about an ink jet type recording device using drawing 1 . Drawing 1 is the top view showing the basic configuration of the ink jet type recording device concerning the operation gestalt of this invention. The timing belt 3 driven by the carriage motor 2 is equipped with the carriage shown with the sign 1 in drawing. And it is constituted so that it may show around at the guide member 4 and both-way migration may be carried out in the main scanning direction which is the

longitudinal direction of the paper feed member 5, i.e., the cross direction of a record form. Moreover, although not shown in the inferior-surface-of-tongue section of this carriage 1 at drawing 1, said paper feed member 5 is countered and equipped with the recording head 6 (it illustrates to drawing 2) of an ink jet type.

[0020] Furthermore, the subtanks 7a-7d for supplying the ink from the Maine tank (after-mentioned) are carried in said recording head 6 at said carriage 1. These four subtanks 7a-7d are provided corresponding to each ink of black, yellow, a Magenta, and cyanogen, in order to store each ink temporarily in the interior. And it consists of Maine tanks 9a-9d as an ink cartridge with which the cartridge holder 8 arranged at the body of equipment was loaded so that each ink may be supplied through the ink supply tubes 10 and 10 which consist of a flexible material, and --.

[0021] In addition, as for each above mentioned Maine tanks 9a-9d as an ink cartridge, the outline configuration is formed in the shape of flat. And in said cartridge holder 8, it is arranged in the condition every so-called length so that a flat-like side may counter a vertical plane, respectively. <BR> [0022] On the other hand, the capping means 11 which can close the nozzle forming face of said recording head 6 is arranged in the non-printing area on the moving trucking of said carriage 1 (home position). Cap member 11a formed in the top-face section of this capping means 11 with flexible materials, such as rubber which can close the nozzle forming face of said recording head 6, is arranged. And when said carriage 1 moves to a home position, it is constituted so that the nozzle forming face of said recording head 6 can be closed by said cap member 11a.

[0023] This cap member 11a closes the nozzle forming face of said recording head 6 during the idle period of a recording device, and functions as a lid which prevents desiccation of a nozzle orifice. Moreover, although not shown in drawing at this cap member 11a, the end of the tube in a suction pump (tube pump) is connected, and the negative pressure by the suction pump is made to act on said recording head 6, and it is constituted so that cleaning actuation which carries out suction discharge of the ink from this recording head 6 may be performed. And the printing area side of said capping means 11 is adjoined, and the wiping member 12 by elastic materials, such as rubber, is arranged, and it is constituted so that the nozzle forming face of a recording head 6 may be wiped away if needed and it can clean.

[0024] Next, it explains about the ink distribution system of the recording device constituted in this way using drawing 1 and drawing 2. Drawing 2 is the sectional view showing typically the configuration of the ink distribution system in the recording device of drawing 1, in this drawing, the sign same about the same member as drawing 1 is attached, and detailed explanation is omitted. In drawing 2, a sign 21 shows an air booster pump. The air pressurized by this air booster pump 21 is constituted so that a pressure regulating valve 22 may be supplied and each Maine tanks 9a-9d (it represents in drawing 2 and a sign 9 shows.) further described above through the pressure sensor 23 may be supplied, respectively.

[0025] In addition, said pressure regulating valve 22 has the function to make the predetermined range maintain the pneumatic pressure which joins each Maine tanks 9a-9d as a clausilium condition, when the pneumatic pressure pressurized by the air booster pump 21 reaches more than predetermined.

[0026] Moreover, said pressure sensor 23 detects the pneumatic pressure pressurized by the air booster pump 21, and functions as controlling the drive of the air booster pump 21.

That is, when it is detected that the pneumatic pressure pressurized by the air booster pump 21 reached the predetermined pressure, the drive of the air booster pump 21 is stopped. Moreover, when having become below the pressure as which pneumatic pressure was determined by the pressure sensor 23 is detected, the air booster pump 21 is made to drive. Therefore, the pneumatic pressure which joins each Maine tanks 9a-9d described above by this repeat is maintained in the predetermined range.

[0027] The ink pack 24 formed in the outline case of said Maine tank 9 (ink cartridge) with the flexible material which enclosed ink as shown in drawing 2 is contained. And the space formed in the Maine tank 9 and the ink pack 24 constitutes the pressure room 25, and it is constituted so that the pressurization air from the air booster pump 21 which minded said pressure regulating valve 22 and the pressure sensor 23 in this pressure room 25 may be supplied.

[0028] By this configuration, each ink pack 24 contained in each of said Maine tank 9a-9d receives a pressure with pressurization air, respectively, and is made as [ occur / to each subtanks 7a-7d / from each Maine tanks 9a-9d / the ink style by the predetermined pressure ].

[0029] In addition, the ink pressurized in said each Maine tanks 9a-9d is supplied to each subtanks 7a-7d (it represents in drawing 2 and a sign 7 shows.) carried in carriage 1 through each ink supply bulbs 26 and 26, -- and each ink supply tubes 10 and 10, and --.

[0030] Next, it explains about the subtank which is the important section of this invention using drawing 1 thru/or drawing 4 . Drawing 3 (a) - (d) is the left side view showing the subtank of the ink jet type recording apparatus concerning the operation gestalt of this invention, a front view, a sectional view, and a right side view. Drawing 4 (a) - (c) is a top view shown in order to explain actuation of an amount detection means of ink to detect the amount of ink in the subtank shown in drawing 3 . Said subtank 7 shown in drawing 1 thru/or drawing 4 has the tanks 7A and 7B of two upper and lower sides which each opens for free passage mutually, and is connected to said Maine tank 9 through the ink supply tube 10.

[0031] Said tank 7A consists of a tank wall 32 of the flat-surface circle configuration which blockades the box-like tank body 31 which has fenestra rotunda 31a opened to the method of right-hand side, and circular window 31a of this tank body 31, and is arranged in the upper part location of said recording head 6. Besides, the ink room 34 of the shape of a cylinder which is open for free passage to the ink derivation opening 33 which derives ink to said recording head 6, and this ink derivation opening 33 is established in way tank 7A. Moreover, the circulation opening 35 which is located under said ink derivation opening 33, and is open for free passage in said ink room 34 is formed in tank 7A. And in said tank 7A, it has the valve seat 50 which projects in said ink room 34, and the check valve 36 made into a valve-opening condition is arranged by generating negative pressure in said recording head 6 side.

[0032] In addition, said check valve 36 is equipped with the compression coil spring 52 which always gives snapping power in the direction which blockades said through-hole 51a in the valve element 51 (thin film) and this valve element 51 of the flat-surface circle configuration of having through-hole 51a in a core. And it is constituted so that it can move in the direction (it estranges from a valve seat 50) which a valve element 51 resists the snapping power of the compression coil spring 52 at the time of the regurgitation of the ink from a recording head 6, and opens through-hole 51a. Moreover, said tank wall 32

is formed with the rigid film of the flat-surface circle configuration of having ink-proof nature, and moisture and gas impermeability.

[0033] On the other hand, said tank 7B consists of a tank wall 38 of the flat-surface circle configuration which blockades the box-like tank body 37 which has said fenestra rotunda 31a and fenestra rotunda 37a similarly opened to the method of right-hand side, and fenestra rotunda 37a of this tank body 37, and is arranged under said tank 7A. The ink room 40 (the ink of the specified quantity stores) of the shape of a cylinder which is open for free passage to the ink inlet 39 which introduces ink through said ink supply tube 10 from said Maine tank 9, and this ink inlet 39 is established in this lower part tank 7B. Moreover, the circulation opening 41 which is located above said ink inlet 39, and is open for free passage in the ink room 40 is formed in tank 7B. In addition, in said ink room 40, it is arranged so that the filter (not shown) which catches the dust in ink etc. may blockade said circulation opening 41.

[0034] The first ink passage 42 which is open for free passage to said both circulation openings 35 and 41, and extends in the direction of a vertical is established in the crosswise center section of the left-hand side end face in said both tanks 7A and 7B. Moreover, it is open for free passage to said ink derivation opening 33 and said recording head 6, and the second ink passage 43 which extends in a horizontal and the direction of a vertical is established in said both tanks 7A and 7B. In addition, as for said both ink passage 42 and 43, a part of the passage wall is formed with transparency plastic film 42a and 43a.

[0035] Said tank wall 38 has flexibility, ink-proof nature, and gas and moisture impermeability, and is formed with the thin film of the flat-surface circle configuration which carries out elastic deformation by change of the internal pressure in said ink room 40. And if pressure fluctuation is in the ink in said ink supply tube 10, the tank wall 38 carries out elastic deformation by pressure (volume) change in said tank 7B, and it is constituted so that this pressure (volume) change may be absorbed.

[0036] Moreover, in the method edge of right-hand side edge presence in said tank 7B, elastic maintenance of the piece 44 of detection which extends horizontally through the circle core of said tank wall 38 is carried out. As shown in drawing 4 (a) - (c), deformation transfer section 44b pasted up on the core of magnet attaching part 44a which holds a magnet 45 on the outside of said subtank 7, and said tank wall 38 is prepared in this piece 44 of detection. And in the left-hand side end-face back edge in said tank 7B, the galvanomagnetic devices 46, such as a hall device corresponding to said magnet 45, are arranged through the piece 47 of component attachment.

[0037] This constitutes an amount detection means of ink to generate an electrical output by the galvanomagnetic device 46, according to the amount of line of magnetic force with the magnet 45 according to the elastic deformation of the tank wall 38. Therefore, when the amount of ink in the subtank 7 decreases, as shown in drawing 4 (a), the tank wall 38 carries out elastic deformation inside lower part tank 7B, as shown in this drawing (a) from the location which the piece 44 of detection shows in this drawing (b) in connection with this, elastic deformation is carried out, and a magnet 45 approaches a galvanomagnetic device 46. On the other hand, when the amount of ink in the subtank 7 increases, as shown in drawing 4 (c), the tank wall 38 carries out elastic deformation to the outside of lower part tank 7B, as shown in this drawing (c) from the location which the piece 44 of detection shows in this drawing (b) in connection with this, elastic

deformation is carried out, and a magnet 45 keeps away from a galvanomagnetic device 46. For this reason, the electrical output of the galvanomagnetic device 46 by migration of a magnet 45 is detectable as an amount of ink in the subtank 7.

[0038] Next, it explains using drawing 2 and drawing 5 (a), and (b) about the ink supply approach (ink supply to a recording head from the Maine tank) of the ink jet type recording device in this operation gestalt. Drawing 5 (a) and (b) are sectional views shown in order to explain actuation of the subtank in the ink jet type recording apparatus concerning the operation gestalt of this invention. First, in drawing 2, if the ink pack 24 in the Maine tank 9 is pressurized by the air booster pump 21, the ink in the ink pack 24 will pass the ink supply tube 10, and will flow from the ink inlet 39 in lower part tank 7B (ink room 40) in the subtank 7.

[0039] In this case, if pressure fluctuation is in the ink in the ink supply tube 10, according to this fluctuating pressure, the tank wall 38 will carry out elastic deformation, and the volume of lower part tank 7B will change. That is, if the pressure fluctuation of ink is large, as shown in drawing 5 (a), elastic deformation will be carried out to the side (outside) to which the tank wall 38 enlarges the internal volume (pressure) of the ink room 40, and this volume (pressure) change will be absorbed. On the other hand, if the pressure fluctuation of ink is small, as shown in drawing 5 (b), elastic deformation will be carried out to the side (inside) to which the tank wall 38 makes the internal volume of the ink room 40 small, and this volume change will be absorbed. Thereby, the pressure fluctuation produced in the ink in the ink supply tube 10 does not affect the regurgitation of the ink droplet from a recording head 6.

[0040] Next, if negative pressure is generated in order to form a meniscus in a recording head 6, a check valve 36 will be in a valve-opening condition, the ink in the ink room 40 will flow in the first ink passage 42 from the circulation opening 41, and the ink in this first ink passage 42 will flow in the ink room 34 of upper part tank 7A from the circulation opening 35. And the ink in the ink room 34 passes through-hole 51a, flows in the second ink passage 43 from the ink derivation opening 33, and flows into a recording head 6 from this second ink passage 43. Thus, ink is supplied to a recording head 6 through the ink supply tube 10 and the subtank 7 from the Maine tank 9.

[0041] Therefore, in this operation gestalt, since ink can be supplied to a recording head 6 with the ink supply system of closed mold, air bubbles cannot be contained in ink within the subtank 7 like before at the time of ink supply, but whenever [ degassing / of ink ] can be guaranteed, and good printing can be realized. Moreover, in this operation gestalt, since the negative pressure which supply of the ink from the subtank 7 to a recording head 6 generates in a recording head side can perform, the height dimension of the subtank 7 can be shortened and the miniaturization of the whole subtank can be attained.

[0042] In addition, in this operation gestalt, by the ink from the Maine tank 9 being supplied to the subtank 7 by pumping pressure, since the ink from the subtank 7 does not need to take into consideration strictly the height location of the recording head [ as opposed to the Maine tank 9 in having considered as the structure supplied directly (a tube is not minded) at a recording head 6 ] 6, the degree of freedom on components arrangement can be raised. Moreover, in this operation gestalt, since constraint of tube (ink supply tube) leading about decreases, that it is not necessary to take into consideration the height location of a recording head 6 strictly can also raise the degree of freedom on a tube dimension (die-length dimension and diameter size method) setup.

Moreover, in this operation gestalt, although the case where detection of the amount of ink was performed using a hall device was explained, this invention is not limited to this, but even if it uses a location (distance) sensor etc., it may be performed.

[0043] In addition, in this operation gestalt, although the case where supply of the ink from the Maine tank 9 to the subtank 7 was performed by the air booster pump 21 besides the ink supply tube 10 was explained, this invention may not be limited to this but may be performed by the pump (not shown) arranged at the section in the middle of the ink supply tube 10.

[0044]

[Effect of the Invention] While good printing is realizable by the above explanation according to the ink jet type recording device concerning this invention, and its ink supply approach so that clearly, the miniaturization of the whole subtank can be attained.

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## TECHNICAL FIELD

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[Field of the Invention] This invention relates to the ink jet type recording device which equipped the recording head with the two main-sub ink tank (the Maine tank and subtank) for supplying ink, and its ink supply approach.

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## PRIOR ART

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[Description of the Prior Art] The ink jet type recording apparatus is equipped with the recording head which is generally carried on carriage and moves crosswise [ of a record form ], and a paper feed means to move a record form in the migration direction of this recording head, and the direction which intersects perpendicularly relatively. In such an ink jet type recording apparatus, printing to a record form is performed by making an ink droplet breathe out from a recording head based on print data. And black, yellow, cyanogen, and the recording head in which the regurgitation [ each ink of a Magenta ] is possible are carried on carriage, and full color printing is enabled by changing the regurgitation rate of not only the text print in black ink but each ink.

[0003] For this reason, the ink cartridge which supplies each ink to a recording head is arranged in the body of equipment. If it is in the usual ink jet type recording apparatus, each ink cartridge in which the ink of said black, yellow, cyanogen, and a Magenta was stored is laid on carriage, and moves with carriage. On the other hand, in order to make it correspond to comparatively a lot of printing in this kind with which for example, for office or business use is provided of recording device, the mass ink cartridge in which each above mentioned ink was stored is not arranged on carriage, but is arranged at the body side of equipment.

[0004] Moreover, while arranging the Maine tank as an ink cartridge to the body side of equipment (cartridge holder), the recording device of the format which arranges a subtank on the carriage with which the recording head was carried is also offered. And ink is supplied from each Maine tank through an ink supply tube to each subtank, respectively, and it is constituted so that ink may be further supplied from each subtank to

a recording head, respectively.

[0005] In such a recording device, performing printing, in order to raise a throughput, ink is serially supplied from each Maine tank to each subtank, and a function which is stabilized and supplies ink from each subtank to a recording head, respectively is called for.

[0006] By pressurizing the ink pack in the Maine tank with air as a means for making such a function satisfy, for example, an ink style is generated from the Maine tank to a subtank, and the configuration which enables supply of ink to a subtank is adopted suitably. In addition, in each subtank carried on carriage, it becomes possible to always store the ink of about 1 quantum in each subtank by adopting the configuration which can adjust the amount of acceptance of the ink from the Maine tank according to consumption of the ink in a recording head.

[0007] By the way, in the latest recording apparatus, carriage is increasingly moved from the purpose which aims at improvement in a recording rate at high speed. In such a recording apparatus, by elongation and crookedness of the ink supply tube accompanying the acceleration and deceleration of carriage, pressure fluctuation arises in the internal ink, and the regurgitation of the ink droplet from a recording head is made unstable. For this reason, a subtank is made to open wide in atmospheric air, the fluctuating pressure described above from this clear aperture is missed, and the ink supply system of the open sand mold which supplies the ink stored in the subtank to a recording head according to that water head difference is adopted.

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## EFFECT OF THE INVENTION

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[Effect of the Invention] While good printing is realizable by the above explanation according to the ink jet type recording device concerning this invention, and its ink supply approach so that clearly, the miniaturization of the whole subtank can be attained.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, that an ink supply system is an open sand mold has the problem as shown below. That is, in order that a subtank may open in atmospheric air, it is the problem that air bubbles will be able to be contained in ink within a subtank at the time of ink supply, whenever [ degassing / of the ink supplied to a recording head ] cannot be guaranteed, and good printing cannot be realized.

Moreover, since supply of the ink from a subtank to a recording head is performed by the water head difference of the ink in a subtank, it will be necessary to fully secure the height dimension of a subtank, and there is also a problem that the whole subtank is enlarged.

[0009] It aims at offering the ink jet type recording device which can attain the miniaturization of the whole subtank, and its ink supply approach while this invention is made in order to solve such a technical technical problem, and it can realize good printing.

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## MEANS

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[Means for Solving the Problem] The ink jet type recording device concerning this invention made in order to attain the above mentioned purpose The carriage to which it can go and come back, and the recording head with which this carriage is equipped and which carries out the regurgitation of the ink droplet corresponding to print data, It has the subtank which has the tank of two upper and lower sides which connect with the Maine tank, this Maine tank, and said recording head for supplying ink to this recording head, and said carriage is equipped, and each opens for free passage mutually. It is formed by the ink tank which has ink derivation opening with which the upper part tank of this subtank derives ink to said recording head. It is characterized by being formed by the ink tank which a lower part tank has the ink inlet which introduces ink from said Maine tank, and carries out elastic deformation according to change of internal pressure. [0011] Thus, since it is constituted, after the ink in the Maine tank flowing in the lower part tank of a subtank by pumping pressure at the time of ink supply and flowing on an upper part tank from this lower part tank further, a recording head is supplied from this upper part tank. Under the present circumstances, if pressure fluctuation arises in a lower part tank (ink in the ink supply tube which connects the Maine tank and a subtank), according to change of internal pressure (volume), a lower part tank will carry out elastic deformation, and this pressure (volume) change will be absorbed.

[0012] Therefore, since the ink from the Maine tank can be supplied to a recording head with the ink supply system of closed mold, air bubbles cannot be contained in ink within a subtank like before at the time of ink supply, but whenever [ degassing / of ink ] can be guaranteed, and good printing can be realized. Moreover, since supply of the ink from a subtank to a recording head can carry out with the negative pressure generated in a recording head side, the height dimension of a subtank can be shortened and the miniaturization of the whole subtank can also be attained.

[0013] In this case, it is desirable for some tank walls in said lower part tank to consist of elastic membrane. Thus, since it is constituted, if pressure fluctuation arises in a lower part tank, some tank walls will carry out elastic deformation according to the pressure variation in a lower part tank.

[0014] And said elastic membrane is considered as the configuration currently formed with the ingredient which has flexibility, ink-proof nature, and moisture and gas impermeability. Thus, since it is constituted, a subtank with the elastic membrane which moisture and gas did not penetrate and was excellent in flexibility and ink-proof nature can be obtained.

[0015] Moreover, it is desirable to arrange the check valve opened by generating negative pressure in said upper part tank at said recording head side. Thus, since it is constituted, negative pressure is generated, a check valve is made into a valve-opening condition, and supply of the ink to a recording head becomes possible from the Maine tank through a subtank at a recording head side.

[0016] And it is desirable to have an amount detection means of ink by which the elastic deformation detects the amount of ink in said subtank. Thus, since it is constituted, by the amount detection means of ink, the elastic deformation of a subtank is detected and the

amount of ink in a subtank is managed.

[0017] On the other hand, the ink supply approach of the ink jet type recording device concerning this invention The carriage to which it can go and come back, and the recording head with which this carriage is equipped and which carries out the regurgitation of the ink droplet corresponding to print data, The Maine tank for supplying ink to this recording head by pumping pressure, It has the subtank which has the tank of two upper and lower sides which connect with this Maine tank and said recording head, and said carriage is equipped, and each opens for free passage mutually. It is the approach of supplying ink to said recording head from said Maine tank through this subtank, and in supplying ink to said recording head from said Maine tank, it is characterized by carrying out elastic deformation of said lower part tank according to change of internal pressure.

[0018] Since it is such an approach and the ink from the Maine tank can be supplied to a recording head with the ink supply system of closed mold, air bubbles are not contained in ink within a subtank like before at the time of ink supply, but the ink jet type recording device which guarantees whenever [ degassing / of ink ] and realizes good printing can be obtained. Moreover, since supply of the ink from a subtank to a recording head can carry out with the negative pressure by the side of a recording head to generate, the height dimension of a subtank can be shortened and the ink jet type recording device which can attain the miniaturization of the whole subtank can also be obtained.

[0019]

[Embodiment of the Invention] Hereafter, based on the gestalt of operation shown in drawing, it explains about the ink jet type recording device with which this invention was applied, and its ink supply approach. First, it explains about an ink jet type recording device using drawing 1 . Drawing 1 is the top view showing the basic configuration of the ink jet type recording device concerning the operation gestalt of this invention. The timing belt 3 driven by the carriage motor 2 is equipped with the carriage shown with the sign 1 in drawing. And it is constituted so that it may show around at the guide member 4 and both-way migration may be carried out in the main scanning direction which is the longitudinal direction of the paper feed member 5, i.e., the cross direction of a record form. Moreover, although not shown in the inferior-surface-of-tongue section of this carriage 1 at drawing 1 , said paper feed member 5 is countered and equipped with the recording head 6 (it illustrates to drawing 2 ) of an ink jet type.

[0020] Furthermore, the subtanks 7a-7d for supplying the ink from the Maine tank (after-mentioned) are carried in said recording head 6 at said carriage 1. These four subtanks 7a-7d are provided corresponding to each ink of black, yellow, a Magenta, and cyanogen, in order to store each ink temporarily in the interior. And it consists of Maine tanks 9a-9d as an ink cartridge with which the cartridge holder 8 arranged at the body of equipment was loaded so that each ink may be supplied through the ink supply tubes 10 and 10 which consist of a flexible material, and --.

[0021] In addition, as for each above mentioned Maine tanks 9a-9d as an ink cartridge, the outline configuration is formed in the shape of flat. And in said cartridge holder 8, it is arranged in the condition every so-called length so that a flat-like side may counter a vertical plane, respectively.

[0022] On the other hand, the capping means 11 which can close the nozzle forming face of said recording head 6 is arranged in the non-printing area on the moving trucking of

said carriage 1 (home position). Cap member 11a formed in the top-face section of this capping means 11 with flexible materials, such as rubber which can close the nozzle forming face of said recording head 6, is arranged. And when said carriage 1 moves to a home position, it is constituted so that the nozzle forming face of said recording head 6 can be closed by said cap member 11a.

[0023] This cap member 11a closes the nozzle forming face of said recording head 6 during the idle period of a recording device, and functions as a lid which prevents desiccation of a nozzle orifice. Moreover, although not shown in drawing at this cap member 11a, the end of the tube in a suction pump (tube pump) is connected, and the negative pressure by the suction pump is made to act on said recording head 6, and it is constituted so that cleaning actuation which carries out suction discharge of the ink from this recording head 6 may be performed. And the printing area side of said capping means 11 is adjoined, and the wiping member 12 by elastic materials, such as rubber, is arranged, and it is constituted so that the nozzle forming face of a recording head 6 may be wiped away if needed and it can clean.

[0024] Next, it explains about the ink distribution system of the recording device constituted in this way using drawing 1 and drawing 2 . Drawing 2 is the sectional view showing typically the configuration of the ink distribution system in the recording device of drawing 1 , in this drawing, the sign same about the same member as drawing 1 is attached, and detailed explanation is omitted. In drawing 2 , a sign 21 shows an air booster pump. The air pressurized by this air booster pump 21 is constituted so that a pressure regulating valve 22 may be supplied and each Maine tanks 9a-9d (it represents in drawing 2 and a sign 9 shows.) further described above through the pressure sensor 23 may be supplied, respectively.

[0025] In addition, said pressure regulating valve 22 has the function to make the predetermined range maintain the pneumatic pressure which joins each Maine tanks 9a-9d as a clausium condition, when the pneumatic pressure pressurized by the air booster pump 21 reaches more than predetermined.

[0026] Moreover, said pressure sensor 23 detects the pneumatic pressure pressurized by the air booster pump 21, and functions as controlling the drive of the air booster pump 21. That is, when it is detected that the pneumatic pressure pressurized by the air booster pump 21 reached the predetermined pressure, the drive of the air booster pump 21 is stopped. Moreover, when having become below the pressure as which pneumatic pressure was determined by the pressure sensor 23 is detected, the air booster pump 21 is made to drive. Therefore, the pneumatic pressure which joins each Maine tanks 9a-9d described above by this repeat is maintained in the predetermined range.

[0027] The ink pack 24 formed in the outline case of said Maine tank 9 (ink cartridge) with the flexible material which enclosed ink as shown in drawing 2 is contained. And the space formed in the Maine tank 9 and the ink pack 24 constitutes the pressure room 25, and it is constituted so that the pressurization air from the air booster pump 21 which minded said pressure regulating valve 22 and the pressure sensor 23 in this pressure room 25 may be supplied.

[0028] By this configuration, each ink pack 24 contained in each of said Maine tank 9a-9d receives a pressure with pressurization air, respectively, and is made as [ occur / to each subtanks 7a-7d / from each Maine tanks 9a-9d / the ink style by the predetermined pressure ].

[0029] In addition, the ink pressurized in said each Maine tanks 9a-9d is supplied to each subtanks 7a-7d (it represents in drawing 2 and a sign 7 shows.) carried in carriage 1 through each ink supply bulbs 26 and 26, -- and each ink supply tubes 10 and 10, and --.

[0030] Next, it explains about the subtank which is the important section of this invention using drawing 1 thru/or drawing 4 . Drawing 3 (a) - (d) is the left side view showing the subtank of the ink jet type recording apparatus concerning the operation gestalt of this invention, a front view, a sectional view, and a right side view. Drawing 4 (a) - (c) is a top view shown in order to explain actuation of an amount detection means of ink to detect the amount of ink in the subtank shown in drawing 3 . Said subtank 7 shown in drawing 1 thru/or drawing 4 has the tanks 7A and 7B of two upper and lower sides which each opens for free passage mutually, and is connected to said Maine tank 9 through the ink supply tube 10.

[0031] Said tank 7A consists of a tank wall 32 of the flat-surface circle configuration which blockades the box-like tank body 31 which has fenestra rotunda 31a opened to the method of right-hand side, and circular window 31a of this tank body 31, and is arranged in the upper part location of said recording head 6. Besides, the ink room 34 of the shape of a cylinder which is open for free passage to the ink derivation opening 33 which derives ink to said recording head 6, and this ink derivation opening 33 is established in way tank 7A. Moreover, the circulation opening 35 which is located under said ink derivation opening 33, and is open for free passage in said ink room 34 is formed in tank 7A. And in said tank 7A, it has the valve seat 50 which projects in said ink room 34, and the check valve 36 made into a valve-opening condition is arranged by generating negative pressure in said recording head 6 side.

[0032] In addition, said check valve 36 is equipped with the compression coil spring 52 which always gives snapping power in the direction which blockades said through-hole 51a in the valve element 51 (thin film) and this valve element 51 of the flat-surface circle configuration of having through-hole 51a in a core. And it is constituted so that it can move in the direction (it estranges from a valve seat 50) which a valve element 51 resists the snapping power of the compression coil spring 52 at the time of the regurgitation of the ink from a recording head 6, and opens through-hole 51a. Moreover, said tank wall 32 is formed with the rigid film of the flat-surface circle configuration of having ink-proof nature, and moisture and gas impermeability.

[0033] On the other hand, said tank 7B consists of a tank wall 38 of the flat-surface circle configuration which blockades the box-like tank body 37 which has said fenestra rotunda 31a and fenestra rotunda 37a similarly opened to the method of right-hand side, and fenestra rotunda 37a of this tank body 37, and is arranged under said tank 7A. The ink room 40 (the ink of the specified quantity stores) of the shape of a cylinder which is open for free passage to the ink inlet 39 which introduces ink through said ink supply tube 10 from said Maine tank 9, and this ink inlet 39 is established in this lower part tank 7B. Moreover, the circulation opening 41 which is located above said ink inlet 39, and is open for free passage in the ink room 40 is formed in tank 7B. In addition, in said ink room 40, it is arranged so that the filter (not shown) which catches the dust in ink etc. may blockade said circulation opening 41.

[0034] The first ink passage 42 which is open for free passage to said both circulation openings 35 and 41, and extends in the direction of a vertical is established in the crosswise center section of the left-hand side end face in said both tanks 7A and 7B.

Moreover, it is open for free passage to said ink derivation opening 33 and said recording head 6, and the second ink passage 43 which extends in a horizontal and the direction of a vertical is established in said both tanks 7A and 7B. In addition, as for said both ink passage 42 and 43, a part of the passage wall is formed with transparency plastic film 42a and 43a.

[0035] Said tank wall 38 has flexibility, ink-proof nature, and gas and moisture impermeability, and is formed with the thin film of the flat-surface circle configuration which carries out elastic deformation by change of the internal pressure in said ink room 40. And if pressure fluctuation is in the ink in said ink supply tube 10, the tank wall 38 carries out elastic deformation by pressure (volume) change in said tank 7B, and it is constituted so that this pressure (volume) change may be absorbed.

[0036] Moreover, in the method edge of right-hand side edge presence in said tank 7B, elastic maintenance of the piece 44 of detection which extends horizontally through the circle core of said tank wall 38 is carried out. As shown in drawing 4 (a) - (c), deformation transfer section 44b pasted up on the core of magnet attaching part 44a which holds a magnet 45 on the outside of said subtank 7, and said tank wall 38 is prepared in this piece 44 of detection. And in the left-hand side end-face back edge in said tank 7B, the galvanomagnetic devices 46, such as a hall device corresponding to said magnet 45, are arranged through the piece 47 of component attachment.

[0037] This constitutes an amount detection means of ink to generate an electrical output by the galvanomagnetic device 46, according to the amount of line of magnetic force with the magnet 45 according to the elastic deformation of the tank wall 38. Therefore, when the amount of ink in the subtank 7 decreases, as shown in drawing 4 (a), the tank wall 38 carries out elastic deformation inside lower part tank 7B, as shown in this drawing (a) from the location which the piece 44 of detection shows in this drawing (b) in connection with this, elastic deformation is carried out, and a magnet 45 approaches a galvanomagnetic device 46. On the other hand, when the amount of ink in the subtank 7 increases, as shown in drawing 4 (c), the tank wall 38 carries out elastic deformation to the outside of lower part tank 7B, as shown in this drawing (c) from the location which the piece 44 of detection shows in this drawing (b) in connection with this, elastic deformation is carried out, and a magnet 45 keeps away from a galvanomagnetic device 46. For this reason, the electrical output of the galvanomagnetic device 46 by migration of a magnet 45 is detectable as an amount of ink in the subtank 7.

[0038] Next, it explains using drawing 2 and drawing 5 (a), and (b) about the ink supply approach (ink supply to a recording head from the Maine tank) of the ink jet type recording device in this operation gestalt. Drawing 5 (a) and (b) are sectional views shown in order to explain actuation of the subtank in the ink jet type recording apparatus concerning the operation gestalt of this invention. First, in drawing 2, if the ink pack 24 in the Maine tank 9 is pressurized by the air booster pump 21, the ink in the ink pack 24 will pass the ink supply tube 10, and will flow from the ink inlet 39 in lower part tank 7B (ink room 40) in the subtank 7.

[0039] In this case, if pressure fluctuation is in the ink in the ink supply tube 10, according to this fluctuating pressure, the tank wall 38 will carry out elastic deformation, and the volume of lower part tank 7B will change. That is, if the pressure fluctuation of ink is large, as shown in drawing 5 (a), elastic deformation will be carried out to the side (outside) to which the tank wall 38 enlarges the internal volume (pressure) of the ink

room 40, and this volume (pressure) change will be absorbed. On the other hand, if the pressure fluctuation of ink is small, as shown in drawing 5 (b), elastic deformation will be carried out to the side (inside) to which the tank wall 38 makes the internal volume of the ink room 40 small, and this volume change will be absorbed. Thereby, the pressure fluctuation produced in the ink in the ink supply tube 10 does not affect the regurgitation of the ink droplet from a recording head 6.

[0040] Next, if negative pressure is generated in order to form a meniscus in a recording head 6, a check valve 36 will be in a valve-opening condition, the ink in the ink room 40 will flow in the first ink passage 42 from the circulation opening 41, and the ink in this first ink passage 42 will flow in the ink room 34 of upper part tank 7A from the circulation opening 35. And the ink in the ink room 34 passes through-hole 51a, flows in the second ink passage 43 from the ink derivation opening 33, and flows into a recording head 6 from this second ink passage 43. Thus, ink is supplied to a recording head 6 through the ink supply tube 10 and the subtank 7 from the Maine tank 9.

[0041] Therefore, in this operation gestalt, since ink can be supplied to a recording head 6 with the ink supply system of closed mold, air bubbles cannot be contained in ink within the subtank 7 like before at the time of ink supply, but whenever [ degassing / of ink ] can be guaranteed, and good printing can be realized. Moreover, in this operation gestalt, since the negative pressure which supply of the ink from the subtank 7 to a recording head 6 generates in a recording head side can perform, the height dimension of the subtank 7 can be shortened and the miniaturization of the whole subtank can be attained.

[0042] In addition, in this operation gestalt, by the ink from the Maine tank 9 being supplied to the subtank 7 by pumping pressure, since the ink from the subtank 7 does not need to take into consideration strictly the height location of the recording head [ as opposed to the Maine tank 9 in having considered as the structure supplied directly (a tube is not minded) at a recording head 6 ] 6, the degree of freedom on components arrangement can be raised. Moreover, in this operation gestalt, since constraint of tube (ink supply tube) leading about decreases, that it is not necessary to take into consideration the height location of a recording head 6 strictly can also raise the degree of freedom on a tube dimension (die-length dimension and diameter size method) setup. Moreover, in this operation gestalt, although the case where detection of the amount of ink was performed using a hall device was explained, this invention is not limited to this, but even if it uses a location (distance) sensor etc., it may be performed.

[0043] In addition, in this operation gestalt, although the case where supply of the ink from the Maine tank 9 to the subtank 7 was performed by the air booster pump 21 besides the ink supply tube 10 was explained, this invention may not be limited to this but may be performed by the pump (not shown) arranged at the section in the middle of the ink supply tube 10.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the top view showing the basic configuration of the ink jet type recording device concerning the operation gestalt of this invention.

[Drawing 2] It is the mimetic diagram showing the ink distribution system from the ink

cartridge in the recording apparatus shown in drawing 1 to a recording head.

[Drawing 3] (a) - (d) is the left side view showing the subtank of the ink jet type recording apparatus concerning the operation gestalt of this invention, a front view, a sectional view, and a right side view.

[Drawing 4] (a) - (c) is a top view shown in order to explain actuation of an amount detection means of ink to detect the amount of ink in the subtank shown in drawing 3.

[Drawing 5] (a) And (b) is a sectional view shown in order to explain actuation of the subtank in the ink jet type recording apparatus concerning the operation gestalt of this invention.

[Description of Notations]

- 1 [ ] Carriage
- 2 [ ] Carriage Motor
- 3 [ ] Timing Belt
- 4 [ ] Guide Member
- 5 [ ] Paper Feed Member
- 6 [ ] Recording Head
- 7 (7a, 7b, 7c, 7d) Subtank
- 7A [ ] an upper part tank
- 7B [ ] a lower part tank
- 8 [ ] Cartridge Holder
- 9 (9a, 9b, 9c, 9d) Maine tank (ink cartridge)
- 10 [ ] Ink Supply Tube
- 21 [ ] Air Booster Pump
- 22 [ ] Pressure Regulating Valve
- 23 [ ] Pressure Sensor
- 24 [ ] Ink Pack
- 25 [ ] Pressure Room
- 26 [ ] Ink Supply Bulb
- 31 [ ] Tank Body
- 31a [ ] a fenestra rotunda
- 32 [ ] Tank Wall
- 33 [ ] Ink Derivation Opening
- 34 [ ] Ink Room
- 35 [ ] Circulation Opening
- 36 [ ] Check Valve
- 37 [ ] Body of Ink
- 37a [ ] a fenestra rotunda
- 38 [ ] Tank Wall
- 39 [ ] Ink Inlet
- 40 [ ] Ink Room
- 41 [ ] Circulation Opening
- 42 [ ] First Ink Passage
- 43 [ ] Second Ink Passage
- 44 [ ] Piece of Detection
- 44a [ ] a magnet attaching part
- 44b [ ] the deformation transfer section

- 45 [ ] Magnet
- 46 [ ] Galvanomagnetic Device
- 47 [ ] Piece of Component Attachment
- 51 [ ] Valve Element
- 51a [ ] a through-hole
- 52 [ ] Compression Coil Spring

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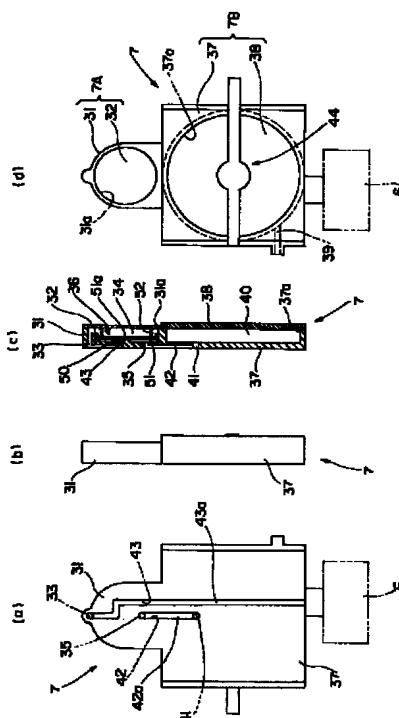
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(54) 【発明の名称】 インクジェット式記録装置およびそのインク供給方法

(57) 【要約】

【課題】 良好的な印刷を実現することができるとともに、サブタンク全体の小型化を図ることができるインクジェット式記録装置およびそのインク供給方法を提供すること。

【解決手段】 印刷データに対応してインク滴を吐出する記録ヘッド 6 と、この記録ヘッド 6 にインクを供給するためのメインタンクと、このメインタンクおよび記録ヘッド 6 に接続されそれが互いに連通する上下二つのタンク 7 A, 7 B を有するサブタンク 7 とを備え、このサブタンク 7 の上方タンク 7 A が記録ヘッド 6 にインクを導出するインク導出口 33 を有するインクタンクによって形成され、下方タンク 7 B がメインタンク 9 からインクをポンプ圧によって導入するインク導入口 39 を有し内部圧力の変化に応じて弾性変形するインクタンクによって形成されている。



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1

## 【特許請求の範囲】

【請求項 1】 往復可能なキャリッジと、このキャリッジに装着され、印刷データに対応してインク滴を吐出する記録ヘッドと、この記録ヘッドにインクを供給するためのメインタンクと、このメインタンクおよび前記記録ヘッドに接続され、かつ前記キャリッジに装着され、それぞれが互いに連通する上下二つのタンクを有するサブタンクとを備え、このサブタンクの上方タンクを、前記記録ヘッドにインクを導出するインク導出口を有するインクタンクによって形成し、下方タンクを、前記メインタンクからのインクをポンプ圧によって導入するインク導入口を有し、内部圧力の変化に応じて弾性変形するインクタンクによって形成したことを特徴とするインクジェット式記録装置。

【請求項 2】 前記下方タンクにおけるタンク壁の一部が、弾性膜からなることを特徴とする請求項 1 に記載されたインクジェット式記録装置。

【請求項 3】 前記弾性膜が、柔軟性、耐インク性および水分・ガス非透過性を有する材料によって形成されていることを特徴とする請求項 2 に記載されたインクジェット式記録装置。

【請求項 4】 前記上方タンク内に、前記記録ヘッド側において負圧を発生させることにより開放することを特徴とする請求項 1 乃至請求項 3 のいずれかに記載されたインクジェット式記録装置。

【請求項 5】 前記サブタンク内のインク量をその弾性変形量によって検出するインク量検出手段を有することを特徴とする請求項 1 乃至請求項 4 のいずれかに記載されたインクジェット式記録装置。

【請求項 6】 往復可能なキャリッジと、このキャリッジに装着され、印刷データに対応してインク滴を吐出する記録ヘッドと、この記録ヘッドにインクを供給するためのメインタンクと、このメインタンクおよび前記記録ヘッドに接続され、かつ前記キャリッジに装着され、それぞれが互いに連通する上下二つのタンクを有するサブタンクとを備え、このサブタンクを介して前記記録ヘッドに前記メインタンクからインクを供給する方法であって、前記メインタンクから前記記録ヘッドにインクを供給するにあたり、前記下方タンクを内部圧力の変化に応じて弾性変形させることを特徴とするインクジェット式記録装置のインク供給方法。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は、記録ヘッドにインクを供給するための主副二つのインクタンク（メインタンクおよびサブタンク）を備えたインクジェット式記録

2

装置およびそのインク供給方法に関する。

## 【0002】

【従来の技術】 インクジェット式記録装置は、一般にキャリッジ上に搭載されて記録用紙の幅方向に移動する記録ヘッドと、この記録ヘッドの移動方向と直交する方向に記録用紙を相対的に移動させる紙送り手段とを備えている。このようなインクジェット式記録装置において、記録用紙に対する印刷は、印刷データに基づいて記録ヘッドよりインク滴を吐出させることにより行われる。そして、キャリッジ上に例えばブラック、イエロー、シアンおよびマゼンタの各インクを吐出可能な記録ヘッドを搭載し、ブラックインクによるテキスト印刷ばかりでなく、各インクの吐出割合を変えることにより、フルカラ一印刷を可能としている。

【0003】 このため、記録ヘッドに各インクを供給するインクカートリッジが装置本体内に配設されている。通常のインクジェット式記録装置にあっては、前記ブラック、イエロー、シアンおよびマゼンタのインクが貯留された各インクカートリッジがキャリッジ上に載置され、キャリッジと共に移動する。一方、例えばオフィス向けまたは業務用に提供されるこの種の記録装置においては、比較的大量の印刷に対応させるために、前記した各インクが貯留された大容量のインクカートリッジがキャリッジ上には配置されず、装置本体側に配置されている。

【0004】 また、装置本体側（カートリッジホルダ）にインクカートリッジとしてのメインタンクを配置するとともに、記録ヘッドが搭載されたキャリッジ上にサブタンクを配置する形式の記録装置も提供されている。そして、各メインタンクから各サブタンクに対してインク供給チューブを介してそれぞれインクを補給し、さらに各サブタンクからそれぞれ記録ヘッドに対してインクを供給するように構成されている。

【0005】 このような記録装置においては、スループットを向上させるために、印刷を実行しながら、各メインタンクから各サブタンクに対して逐次インクを補給し、各サブタンクからそれぞれ記録ヘッドに対してインクを安定して供給するような機能が求められる。

【0006】 このような機能を充足させるための手段としては、例えばメインタンクにおけるインクパックを空気で加圧することにより、メインタンクからサブタンクに対してインク流を発生させて、サブタンクに対してインクの補給を可能にする構成が好適に採用される。加えて、キャリッジ上に搭載された各サブタンクにおいては、記録ヘッドにおけるインクの消費に応じて、メインタンクからのインクの受け入れ量が調整できるような構成を採用することにより、各サブタンクにおいては常にほぼ一定量のインクを貯留することが可能となる。

【0007】 ところで、最近の記録装置においては、記録速度の向上を図る目的から、キャリッジの移動を高速

50

(3)

3

で行うようになってきている。このような記録装置においては、キャリッジの加減速に伴うインク供給チューブの伸張・屈曲によってその内部インクに圧力変動が生じてしまい、記録ヘッドからのインク滴の吐出を不安定にする。このため、サブタンクを大気中に開放させ、この開放口から前記した変動圧力を逃がし、サブタンク内に貯留されたインクをその水頭差によって記録ヘッドに供給する開放型のインク供給方式が採用される。

【0008】

【発明が解決しようとする課題】しかし、インク供給方式が開放型であることは、次に示すような問題を抱えている。すなわち、サブタンクが大気中に開放するため、インク供給時にサブタンク内でインクに気泡が含まれてしまい、記録ヘッドに供給されるインクの脱気度を保証することができず、良好な印刷を実現することができないという問題である。また、サブタンクから記録ヘッドへのインクの供給がサブタンク内におけるインクの水頭差によって行われているため、サブタンクの高さ寸法を十分に確保する必要が生じ、サブタンク全体が大型化するという問題もある。

【0009】本発明は、このような技術的な課題を解決するためになされたものであり、良好な印刷を実現することができるとともに、サブタンク全体の小型化を図ることができるインクジェット式記録装置およびそのインク供給方法を提供することを目的とするものである。

【0010】

【課題を解決するための手段】前記した目的を達成するためになされた本発明に係るインクジェット式記録装置は、往復可能なキャリッジと、このキャリッジに装着され印刷データに対応してインク滴を吐出する記録ヘッドと、この記録ヘッドにインクを供給するためのメインタンクと、このメインタンクおよび前記記録ヘッドに接続されかつ前記キャリッジに装着されそれが互いに連通する上下二つのタンクを有するサブタンクとを備え、このサブタンクの上方タンクが前記記録ヘッドにインクを導出するインク導出口を有するインクタンクによって形成され、下方タンクが前記メインタンクからインクを導入するインク導入口を有し内部圧力の変化に応じて弾性変形するインクタンクによって形成されていることを特徴とする。

【0011】このように構成されているため、インク供給時にメインタンク内のインクがポンプ圧によってサブタンクの下方タンク内に流動し、さらにこの下方タンクから上方タンクに流動した後、この上方タンクから記録ヘッドに供給される。この際、下方タンク内（メインタンクとサブタンクとを接続するインク供給チューブ内のインク）に圧力変動が生じると、内部圧力（容積）の変化に応じて下方タンクが弾性変形し、この圧力（容積）変化が吸収される。

【0012】したがって、密閉型のインク供給方式によ

(3)

4

ってメインタンクからのインクを記録ヘッドに供給することができるため、従来のようにインク供給時にサブタンク内でインクに気泡が含まれず、インクの脱気度を保証して良好な印刷を実現することができる。また、サブタンクから記録ヘッドへのインクの供給が記録ヘッド側で発生する負圧によって行うことができるため、サブタンクの高さ寸法を短縮することができ、サブタンク全体の小型化を図ることもできる。

【0013】この場合、前記下方タンクにおけるタンク壁の一部が、弾性膜からなることが望ましい。このように構成されているため、下方タンク内に圧力変動が生じると、タンク壁の一部が下方タンク内の圧力変化に応じて弾性変形する。

【0014】そして、前記弾性膜が、柔軟性、耐インク性および水分・ガス非透過性を有する材料によって形成されている構成とされる。このように構成されているため、水分およびガスが透過せず、かつ柔軟性および耐インク性にすぐれた弾性膜をもつサブタンクを得ることができる。

【0015】また、前記上方タンク内に、前記記録ヘッド側において負圧を発生させることにより開放する逆止弁が配置されていることが望ましい。このように構成されているため、記録ヘッド側において負圧を発生させて逆止弁を開弁状態とし、メインタンクから記録ヘッドへのインクの供給がサブタンクを介して可能となる。

【0016】そして、前記サブタンク内のインク量をその弾性変形量によって検出するインク量検出手段を有することが望ましい。このように構成されているため、インク量検出手段によってサブタンクの弾性変形量を検出し、サブタンク内のインク量が管理される。

【0017】一方、本発明に係るインクジェット式記録装置のインク供給方法は、往復可能なキャリッジと、このキャリッジに装着され印刷データに対応してインク滴を吐出する記録ヘッドと、この記録ヘッドにポンプ圧によってインクを供給するためのメインタンクと、このメインタンクおよび前記記録ヘッドに接続されかつ前記キャリッジに装着されそれが互いに連通する上下二つのタンクを有するサブタンクとを備え、このサブタンクを介して前記記録ヘッドに前記メインタンクからインクを供給する方法であって、前記メインタンクから前記記録ヘッドにインクを供給するにあたり、前記下方タンクを内部圧力の変化に応じて弾性変形させることを特徴とする。

【0018】このような方法であるため、密閉型のインク供給方式によってメインタンクからのインクを記録ヘッドに供給することができるため、従来のようにインク供給時にサブタンク内でインクに気泡が含まれず、インクの脱気度を保証して良好な印刷を実現するインクジェット式記録装置を得ることができる。また、サブタンクから記録ヘッドへのインクの供給が記録ヘッド側での発

(4)

5

生する負圧によって行うことができるため、サブタンクの高さ寸法を短縮することができ、サブタンク全体の小型化が図れるインクジェット式記録装置を得ることもできる。

【0019】

【発明の実施の形態】以下、本発明が適用されたインクジェット式記録装置およびそのインク供給方法につき、図に示す実施の形態に基づいて説明する。先ず、インクジェット式記録装置につき、図1を用いて説明する。図1は、本発明の実施形態に係るインクジェット式記録装置の基本構成を示す平面図である。図中符号1で示すキャリッジは、キャリッジモータ2によって駆動されるタイミングベルト3に装着されている。そして、ガイド部材4に案内されて紙送り部材5の長手方向、すなわち記録用紙の幅方向である主走査方向に往復移動されるように構成されている。また、このキャリッジ1の下面部には、図1には示されていないが、インクジェット式の記録ヘッド6(図2に図示)が前記紙送り部材5に対向して装着されている。

【0020】さらに、前記キャリッジ1には、前記記録ヘッド6にメインタンク(後述)からのインクを供給するためのサブタンク7a～7dが搭載されている。これらサブタンク7a～7dは、その内部において各インクを一時的に貯留するために、ブラック、イエロー、マゼンタおよびシアンの各インクに対応して四個具備されている。そして、装置本体に配置されたカートリッジホルダ8に装填されたインクカートリッジとしてのメインタンク9a～9dから、可撓性材料からなるインク供給チューブ10, 10, …を介して各インクが供給されるように構成されている。

【0021】なお、前記したインクカートリッジとしての各メインタンク9a～9dは、その外郭形状が偏平状に形成されている。そして、前記カートリッジホルダ8において、偏平状の面がそれぞれ鉛直面に対向するように、いわゆる縦置き状態で配置されている。

【0022】一方、前記キャリッジ1の移動経路上における非印字領域(ホームポジション)には、前記記録ヘッド6のノズル形成面を封止することができるキャッピング手段11が配置されている。このキャッピング手段11の上面部には、前記記録ヘッド6のノズル形成面を封止し得るゴム等の可撓性素材により形成されたキャップ部材11aが配置されている。そして、前記キャリッジ1がホームポジションに移動したときに、前記キャップ部材11aによって前記記録ヘッド6のノズル形成面を封止し得るように構成されている。

【0023】このキャップ部材11aは、記録装置の休止期間中において前記記録ヘッド6のノズル形成面を封止し、ノズル開口の乾燥を防止する蓋体として機能する。また、このキャップ部材11aには、図には示されていないが、吸引ポンプ(チューブポンプ)におけるチ

6

ューブの一端が接続され、吸引ポンプによる負圧を前記記録ヘッド6に作用させて、この記録ヘッド6からインクを吸引排出させるクリーニング動作が実行されるように構成されている。そして、前記キャッピング手段11の印字領域側に隣接してゴムなどの弾性素材によるワピング部材12が配置され、必要に応じて記録ヘッド6のノズル形成面を拭して清掃し得るように構成されている。

【0024】次に、このように構成された記録装置のインク供給システムにつき、図1および図2を用いて説明する。図2は図1の記録装置におけるインク供給システムの構成を模式的に示す断面図で、同図において図1と同一の部材については同一の符号を付し、詳細な説明は省略する。図2において、符号21は空気加圧ポンプを示す。この空気加圧ポンプ21により加圧された空気は、圧力調整弁22に供給され、さらに圧力検出器23を介して前記した各メインタンク9a～9d(図2においては代表して符号9で示す。)にそれぞれ供給されるように構成されている。

【0025】なお、前記圧力調整弁22は、空気加圧ポンプ21によって加圧された空気圧が所定以上に達した時に、閉弁状態として各メインタンク9a～9dに加わる空気圧を所定の範囲に維持させる機能を有している。

【0026】また、前記圧力検出器23は、空気加圧ポンプ21によって加圧された空気圧を検知し、空気加圧ポンプ21の駆動を制御するように機能する。すなわち、空気加圧ポンプ21によって加圧された空気圧が所定の圧力に達したことを検出した場合には、空気加圧ポンプ21の駆動を停止させる。また、圧力検出器23によって空気圧が定められた圧力以下となったことを検出した場合には、空気加圧ポンプ21を駆動させる。したがって、この繰り返しによって前記した各メインタンク9a～9dに加わる空気圧は所定の範囲に維持される。

【0027】前記メインタンク9(インクカートリッジ)の外郭ケース内には、図2に示すように、インクを封入した可撓性素材により形成されたインクパック24が収納されている。そして、メインタンク9とインクパック24とで形成される空間が圧力室25を構成しており、この圧力室25内に前記圧力調整弁22、圧力検出器23を介した空気加圧ポンプ21からの加圧空気が供給されるように構成されている。

【0028】この構成により、前記各メインタンク9a～9d内に収納された各インクパック24は、それぞれ加圧空気による圧力を受け、各メインタンク9a～9dから各サブタンク7a～7dに対して所定の圧力によるインク流が発生するようになされる。

【0029】なお、前記各メインタンク9a～9dにおいて加圧されたインクは、各インク補給バルブ26, 26, …および各インク供給チューブ10, 10, …を介して、キャリッジ1に搭載された各サブタンク7a～7

(5)

7

d (図2においては代表して符号7で示す。) に供給される。

【0030】次に、本発明の要部であるサブタンクにつき、図1乃至図4を用いて説明する。図3 (a) ~ (d) は、本発明の実施形態に係るインクジェット式記録装置のサブタンクを示す左側面図、正面図、断面図および右側面図である。図4 (a) ~ (c) は、図3に示すサブタンク内のインク量を検出するインク量検出手段の動作を説明するために示す平面図である。図1乃至図4に示す前記サブタンク7は、それぞれが互いに連通する上下二つのタンク7A, 7Bを有し、前記メインタンク9にインク供給チューブ10を介して接続されている。

【0031】前記タンク7Aは、右側方に開放する円形窓31aを有する箱状のタンク本体31およびこのタンク本体31の円形窓口31aを閉塞する平面円形状のタンク壁32からなり、前記記録ヘッド6の上方位置に配置されている。この上方タンク7Aには、前記記録ヘッド6にインクを導出するインク導出口33およびこのインク導出口33に連通する円柱状のインク室34が設けられている。また、タンク7Aには、前記インク導出口33の下方に位置し、かつ前記インク室34に連通する流通口35が設けられている。そして、前記タンク7A内には、前記インク室34内に突出する弁座50を有し、前記記録ヘッド6側において負圧を発生させることにより開弁状態とする逆止弁36が配置されている。

【0032】なお、前記逆止弁36は、通孔51aを中心部に有する平面円形状の弁体51 (薄膜) およびこの弁体51に前記通孔51aを閉塞するような方向に弾撥力を常時付与する圧縮コイルスプリング52を備えている。そして、記録ヘッド6からのインクの吐出時に弁体51が圧縮コイルスプリング52の弾撥力に抗して通孔51aを開放する (弁座50から離間する) 方向に移動し得るように構成されている。また、前記タンク壁32は、耐インク性および水分・ガス非透過性を有する平面円形状の剛性膜によって形成されている。

【0033】一方、前記タンク7Bは、前記円形窓31aと同様に右側方に開放する円形窓37aを有する箱状のタンク本体37およびこのタンク本体37の円形窓37aを閉塞する平面円形状のタンク壁38からなり、前記タンク7Aの下方に配置されている。この下方タンク7Bには、前記メインタンク9から前記インク供給チューブ10を介してインクを導入するインク導入口39およびこのインク導入口39に連通する円柱状のインク室40 (所定量のインクが貯留) が設けられている。また、タンク7Bには、前記インク導入口39の上方に位置し、かつインク室40に連通する流通口41が設けられている。なお、前記インク室40内には、インク中の塵埃等を捕捉するフィルタ (図示せず) が前記流通口41を閉塞するように配置されている。

8

【0034】前記両タンク7A, 7Bにおける左側端面の幅方向中央部には、前記両流通口35, 41に連通し、かつ鉛直方向に延在する第一インク流路42が設けられている。また、前記両タンク7A, 7Bには、前記インク導出口33および前記記録ヘッド6に連通し、水平・鉛直方向に延在する第二インク流路43が設けられている。なお、前記両インク流路42, 43は、その流路壁の一部が透明プラスチックフィルム42a, 43aによって形成されている。

【0035】前記タンク壁38は、柔軟性、耐インク性およびガス・水分非透過性を有し、前記インク室40における内部圧力の変化によって弾性変形する平面円形状の薄膜によって形成されている。そして、前記インク供給チューブ10内のインクに圧力変動があると、前記タンク7B内の圧力 (容積) 変化によってタンク壁38が弾性変形し、この圧力 (容積) 変化を吸収するように構成されている。

【0036】また、前記タンク7Bにおける右側端面前方端部には、前記タンク壁38の円中心を通って水平方向に延在する検出片44が弾性保持されている。この検出片44には、図4 (a) ~ (c) に示すように、前記サブタンク7の外側でマグネット45を保持するマグネット保持部44aおよび前記タンク壁38の中心部に接着する変形量伝達部44bが設けられている。そして、前記タンク7Bにおける左側端面後方端部には、前記マグネット45に対応するホール素子等の磁電変換素子46が素子取付片47を介して配置されている。

【0037】これにより、タンク壁38の弾性変形量にしたがったマグネット45による磁力線量に応じて、磁電変換素子46により電気的出力を発生するインク量検出手段を構成している。したがって、サブタンク7内のインク量が少なくなった場合には、図4 (a) に示すようにタンク壁38が下方タンク7Bの内側に弾性変形し、これに伴い検出片44が同図 (b) に示す位置から同図 (a) に示すように弾性変形し、マグネット45が磁電変換素子46に近づく。一方、サブタンク7内のインク量が多くなった場合には、図4 (c) に示すようにタンク壁38が下方タンク7Bの外側に弾性変形し、これに伴い検出片44が同図 (b) に示す位置から同図

(c) に示すように弾性変形し、マグネット45が磁電変換素子46から遠ざかる。このため、マグネット45の移動による磁電変換素子46の電気的出力は、サブタンク7内のインク量として検出することができる。

【0038】次に、本実施形態におけるインクジェット式記録装置のインク供給方法 (メインタンクから記録ヘッドへのインク供給) につき、図2および図5 (a), (b) を用いて説明する。図5 (a) および (b) は、本発明の実施形態に係るインクジェット式記録装置におけるサブタンクの動作を説明するために示す断面図である。先ず、図2において、メインタンク9内のインクバ

(6)

9

ック24が空気加圧ポンプ21によって加圧されると、インクパック24内のインクがインク供給チューブ10を通過してサブタンク7における下方タンク7B（インク室40）内にインク導入口39から流入する。

【0039】この場合、インク供給チューブ10内のインクに圧力変動があると、この変動圧力に応じてタンク壁38が弾性変形し、下方タンク7Bの容積が変化する。すなわち、インクの圧力変動が大きいと、図5

（a）に示すように、タンク壁38がインク室40の内部容積（圧力）を大きくする側（外側）に弾性変形し、この容積（圧力）変化が吸収される。一方、インクの圧力変動が小さいと、図5（b）に示すように、タンク壁38がインク室40の内部容積を小さくする側（内側）に弾性変形し、この容積変化が吸収される。これにより、インク供給チューブ10内のインクに生じた圧力変動が記録ヘッド6からのインク滴の吐出に影響を与えることがない。

【0040】次に、記録ヘッド6内にメニスカスを形成するために負圧を発生させると、逆止弁36が開弁状態となり、インク室40内のインクが流通口41から第一インク流路42内に流動し、この第一インク流路42内のインクが流通口35から上方タンク7Aのインク室34内に流入する。そして、インク室34内のインクが通孔51aを通過してインク導出口33から第二インク流路43内に流動し、この第二インク流路43から記録ヘッド6に流入する。このようにして、メインタンク9からインク供給チューブ10およびサブタンク7を介して記録ヘッド6にインクが供給される。

【0041】したがって、本実施形態においては、密閉型のインク供給方式によってインクを記録ヘッド6に供給することができるため、従来のようにインク供給時にサブタンク7内でインクに気泡が含まれず、インクの脱気度を保証して良好な印刷を実現することができる。また、本実施形態においては、サブタンク7から記録ヘッド6へのインクの供給が記録ヘッド側で発生する負圧によって行うことができるため、サブタンク7の高さ寸法を短縮することができ、サブタンク全体の小型化を図ることができる。

【0042】この他、本実施形態において、メインタンク9からのインクがポンプ圧によってサブタンク7に供給され、かつサブタンク7からのインクが記録ヘッド6に直接（チューブを介さず）供給される構造としたことは、メインタンク9に対する記録ヘッド6の高さ位置を厳密に考慮する必要がないため、部品配置上の自由度を高めることができる。また、本実施形態において、記録ヘッド6の高さ位置を厳密に考慮する必要がないことは、チューブ（インク供給チューブ）引き回しの制約が少なくなるため、チューブ外形寸法（長さ寸法および径寸法）設定上の自由度を高めることもできる。また、本実施形態においては、インク量の検出がホール素子を用

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いて行われる場合について説明したが、本発明はこれに限定されず、位置（距離）センサ等を用いても行われ得る。

【0043】なお、本実施形態においては、メインタンク9からサブタンク7へのインクの供給がインク供給チューブ10外の空気加圧ポンプ21によって行われる場合について説明したが、本発明はこれに限定されず、インク供給チューブ10の途中部に配置されるポンプ（図示せず）によって行われるものでもよい。

10 【0044】

【発明の効果】以上の説明で明らかなように、本発明に係るインクジェット式記録装置およびそのインク供給方法によると、良好な印刷を実現することができるとともに、サブタンク全体の小型化を図ることができる。

【図面の簡単な説明】

【図1】本発明の実施形態に係るインクジェット式記録装置の基本構成を示す平面図である。

【図2】図1に示す記録装置におけるインクカートリッジから記録ヘッドに至るインク供給システムを示す模式図である。

【図3】（a）～（d）は、本発明の実施形態に係るインクジェット式記録装置のサブタンクを示す左側面図、正面図、断面図および右側面図である。

【図4】（a）～（c）は、図3に示すサブタンク内のインク量を検出するインク量検出手段の動作を説明するために示す平面図である。

【図5】（a）および（b）は、本発明の実施形態に係るインクジェット式記録装置におけるサブタンクの動作を説明するために示す断面図である。

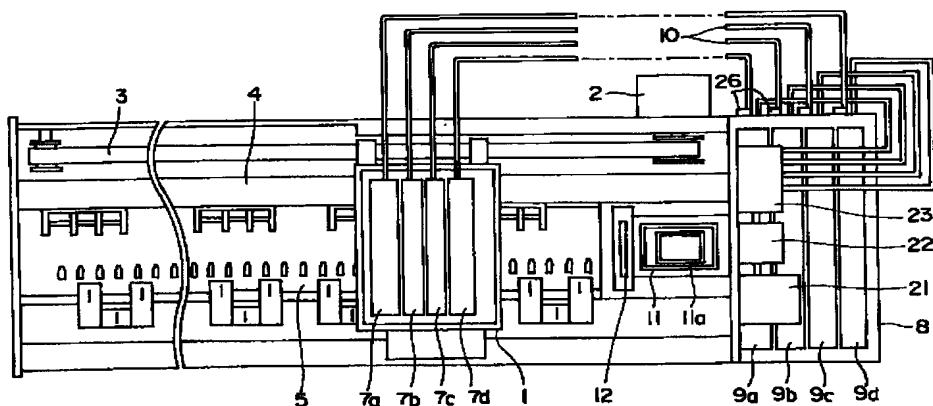
【符号の説明】

1	キャリッジ
2	キャリッジモータ
3	タイミングベルト
4	ガイド部材
5	紙送り部材
6	記録ヘッド
7 (7a, 7b, 7c, 7d)	サブタンク
7A	上方タンク
7B	下方タンク
8	カートリッジホルダ
9 (9a, 9b, 9c, 9d)	メインタンク（インクカートリッジ）
10	インク供給チューブ
21	空気加圧ポンプ
22	圧力調整弁
23	圧力検出器
24	インクパック
25	圧力室
26	インク補給バルブ
31	タンク本体

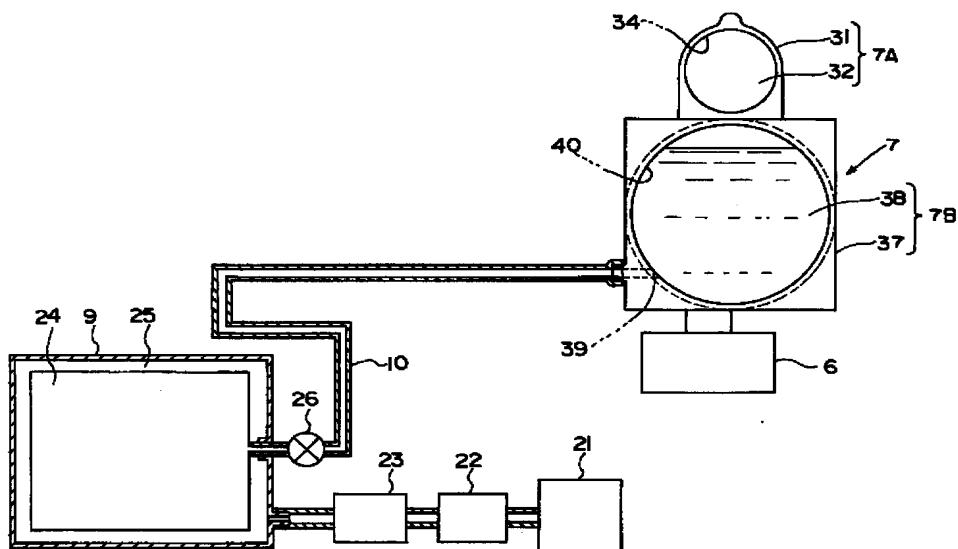
(7)

	11	12	
3 1 a	円形窓	4 2	第一インク流路
3 2	タンク壁	4 3	第二インク流路
3 3	インク導出口	4 4	検出片
3 4	インク室	4 4 a	マグネット保持部
3 5	流通口	4 4 b	変形量伝達部
3 6	逆止弁	4 5	マグネット
3 7	インク本体	4 6	磁電変換素子
3 7 a	円形窓	4 7	素子取付片
3 8	タンク壁	5 1	弁体
3 9	インク導入口	10 5 1 a	通孔
4 0	インク室	5 2	圧縮コイルスプリング
4 1	流通口		

【図1】

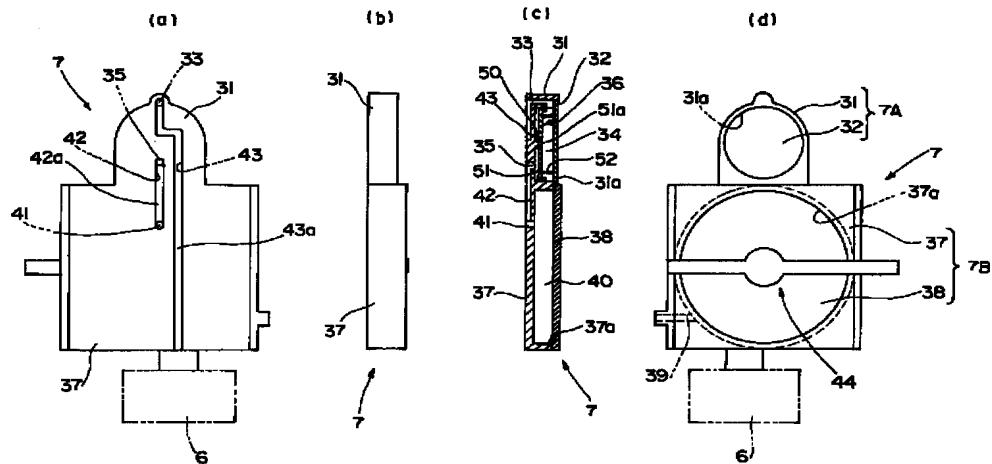


【図2】

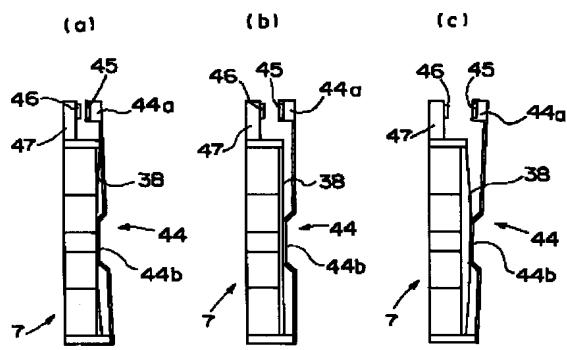


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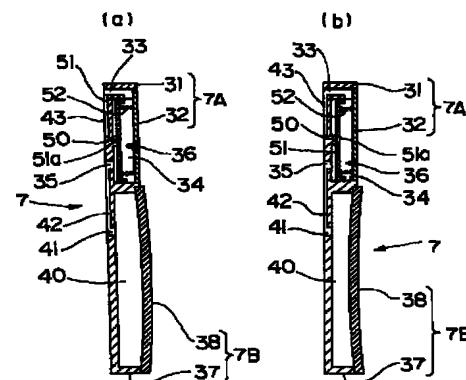
【図3】



【図4】



【図5】



フロントページの続き

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